

## CLAIMS:

1. A persistent p-type group II-VI semiconductor material comprising a thin film of a single crystal group II-VI semiconductor comprising atoms of group II elements and atoms of group VI elements, wherein the group II-VI semiconductor is doped with a p-type dopant, wherein the p-type dopant concentration is sufficient to render the group II-VI semiconductor material in a single crystal form, wherein semiconductor resistivity is less than about 0.5 ohm·cm, and wherein the carrier mobility is greater than about  $0.1 \text{ cm}^2/\text{V}\cdot\text{s}$ .
2. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the group II elements are selected from zinc, cadmium, alkaline earth metals, and mixtures thereof.
3. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the group VI elements are selected from oxygen, sulfur, selenium, tellurium, and mixtures thereof.
4. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the p-type dopant is selected from phosphorus, arsenic, antimony, bismuth, copper, and chalcogenides of the foregoing, and mixtures thereof.
5. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the resistivity is less than about 0.1 ohm·cm.
6. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the resistivity is less than about 0.01 ohm·cm.
7. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the resistivity is less than about 0.001 ohm·cm.
8. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the carrier mobility is greater than  $0.5 \text{ cm}^2/\text{V}\cdot\text{s}$ .
9. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the carrier mobility is greater than  $4 \text{ cm}^2/\text{V}\cdot\text{s}$ .
10. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the p-type dopant concentration is in the range from about  $10^{16}$  to about  $10^{22}$  atoms/cm<sup>3</sup>.

11. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the p-type dopant concentration is greater than about  $10^{16}$  atoms·cm<sup>-3</sup>.
12. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the p-type dopant concentration is in the range from about  $10^{17}$  to  $10^{19}$  atoms·cm<sup>-3</sup>.
13. A persistent p-type group II-VI semiconductor material according to claim 1, wherein the group II-VI semiconductor material is deposited as a thin film on an amorphous self supporting substrate surface.
14. A persistent p-type zinc oxide semiconductor material comprising single crystal zinc oxide that is doped with a quantity of arsenic, wherein the arsenic concentration is sufficient to render the zinc oxide a p-type semiconductor in a single crystal form, wherein semiconductor resistivity is less than about 0.5 ohm·cm, and wherein the carrier mobility is greater than about 0.1 cm<sup>2</sup>/V·s.
15. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the resistivity is less than about 0.1 ohm·cm.
16. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the resistivity is less than about 0.01 ohm·cm.
17. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the resistivity is less than about 0.001 ohm·cm.
18. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the carrier mobility is greater than 0.5 cm<sup>2</sup>/V·s.
19. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the carrier mobility is greater than 4 cm<sup>2</sup>/V·s.
20. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the arsenic concentration is in the range from about  $10^{16}$  to about  $10^{22}$  atoms·cm<sup>-3</sup>.
21. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the arsenic concentration is greater than about  $10^{16}$  atoms·cm<sup>-3</sup>.
22. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the arsenic concentration is in the range from about  $10^{17}$  to  $10^{19}$  atoms·cm<sup>-3</sup>.

23. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the zinc oxide is deposited as a thin film on an amorphous self supporting substrate surface.

24. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the zinc oxide further comprises cadmium oxide.

25. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the zinc oxide further comprises magnesium oxide.

26. A persistent p-type zinc oxide semiconductor material according to claim 14, wherein the zinc oxide is a non-stoichiometric zinc oxide compound.

27. A persistent p-type zinc oxide semiconductor material comprising single crystal zinc oxide that is doped with a quantity of antimony, wherein the antimony concentration is sufficient to render the zinc oxide a p-type semiconductor in a single crystal form, wherein semiconductor resistivity is less than about 0.5 ohm·cm, and wherein the carrier mobility is greater than about 0.1 cm<sup>2</sup>/V·s.

28. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the resistivity is less than about 0.1 ohm·cm.

29. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the resistivity is less than about 0.01 ohm·cm.

30. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the resistivity is less than about 0.001 ohm·cm.

31. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the carrier mobility is greater than 0.5 cm<sup>2</sup>/V·s.

32. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the carrier mobility is greater than 4 cm<sup>2</sup>/V·s.

33. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the antimony concentration is in the range from about 10<sup>16</sup> to about 10<sup>22</sup> atoms·cm<sup>-3</sup>.

34. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the antimony concentration is greater than about 10<sup>16</sup> atoms·cm<sup>-3</sup>.

35. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the antimony concentration is in the range from about 10<sup>17</sup> to 10<sup>19</sup> atoms·cm<sup>-3</sup>.

36. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the zinc oxide is deposited as a thin film on an amorphous self supporting substrate surface.

37. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the zinc oxide further comprises cadmium oxide.

38. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the zinc oxide further comprises magnesium oxide.

39. A persistent p-type zinc oxide semiconductor material according to claim 27, wherein the zinc oxide is a non-stoichiometric zinc oxide compound.

40. A persistent p-type zinc oxide semiconductor material comprising single crystal zinc oxide that is doped with a quantity of a p-type dopant selected from copper oxide, antimony oxide, bismuth oxide, wherein the dopant concentration is sufficient to render the zinc oxide a p-type semiconductor in a single crystal form, wherein semiconductor resistivity is less than about 0.5 ohm·cm, and wherein the carrier mobility is greater than about 0.1 cm<sup>2</sup>/V·s.

41. A persistent p-type zinc oxide semiconductor material according to claim 40, wherein the p-type dopant is copper oxide at a dopant concentration from about 3 to about 10 mole %.

42. A persistent p-type zinc oxide semiconductor material according to claim 40, wherein the p-type dopant is antimony at a dopant concentration from about 1 to about 10 mole %.